

**WHAT IS CLAIMED IS:**

1           1.       A method for restoring a virtual path in an optical network, the method  
2 comprising:

3           identifying a plurality of nodes with resources, wherein said nodes with  
4           resources are ones of said nodes having a resource necessary to support  
5           said virtual path; and  
6           identifying an alternate physical path, said alternate physical path comprising  
7           ones of said nodes with resources.

1           2.       The method of claim 1, further comprising:  
2 restoring said virtual path using said alternate physical path.

1           3.       The method of claim 2, wherein said restoring is done by  
2 configuring said alternate physical path by establishing a communication  
3           connection between said ones of said nodes with resources; and  
4           provisioning said virtual path over said alternate physical path.

1           4.       The method of claim 2, further comprising:  
2 detecting a failure in said virtual path;  
3 said detection of said failure is done by receiving a failure message packet;  
4 said virtual path is provisioned on a physical path between a first and a second  
5           node of said optical network;  
6 said optical network comprises said nodes;  
7 each one of said nodes is coupled to at least one another of said nodes by a  
8           plurality of optical links;  
9 said physical path between said first and said second node comprises a  
10          plurality of intermediate nodes; and  
11 each one of said nodes is coupled to at least one another of said nodes in a  
12          mesh topology.

1           5.       The method of claim 4, wherein said restoring of said virtual path is  
2 completed in less than 2 seconds.

6. The method of claim 4, wherein said restoring of said virtual path is completed in less than 250 milliseconds.

7. The method of claim 4, wherein said first node receives said failure message packet.

8. The method of claim 7, further comprising:

- (i) changing a state of said virtual path to restoring;
- (ii) identifying an adjacent node with required bandwidth for said virtual path;
- (iii) forwarding a resource request packet to said adjacent node with required bandwidth for said virtual path;
- (iv) waiting for a resource response packet for a predetermined time interval; and

if said resource response packet is not received within said predetermined time interval,  
repeating steps (ii) – (iv) for a predefined threshold times.

9. The method of claim 8, further comprising:

if said resource response packet is not received within said predefined threshold time,  
generating a network alarm.

10. The method of claim 8, further comprising:

if said resource response packet is received with at least one error,  
waiting until responses to all resource request packets are received; and  
if said resource response packet is received with no errors,  
determining if a list of allocated ports in said resource response packet is valid.

11. The method of claim 10, further comprising:

if said list of allocated port is valid,

provisioning said virtual path on said allocated ports; and

if said list of allocated ports is invalid,

generating a network alarm.

12. The method of claim 10, further comprising:

if responses to all resource request packets are received with at least one error,

generating a network alarm.

13. The method of claim 9, wherein said predetermined time interval and predefined threshold are dynamically calculated by said network.

14. The method of claim 4, wherein one of said intermediate nodes receives said failure message.

15. The method of claim 14, further comprising:

changing a state of said virtual path to down;

forwarding said failure message to adjacent nodes comprising said virtual path;

initiating a timer for receiving a response to said forwarded failure message;

if said timer expires before said response to said forwarded failure message is received,

releasing resources of said virtual path; and

if said response to said forwarded failure message is received before said timer expires,

stopping said timer, and

releasing resources of said virtual path.

16. The method of claim 4, wherein said second node receives said failure message.

17. The method of claim 16, further comprising:  
 acknowledging said failure message;  
 changing a state of said virtual path to down; and  
 releasing resources of said virtual path.

18. The method of claim 18, wherein one of said intermediate nodes  
 receives said resource request packet.

19. The method of claim 18, further comprising:  
 if said resource request packet includes at least one error,  
     copying said resource request packet to a first resource response  
         packet,  
     decrementing a hop count field in said first resource response packet,  
     adding an error code to said first resource response packet, and  
     responding with said first resource response packet; and  
 if said resource request packet includes no errors,  
     allocating a resource to said virtual path,  
     incrementing a hop count field in said resource request packet,  
     forwarding said resource request packet to an adjacent node having a  
         resource necessary to support said virtual path, and  
     waiting for a second resource response packet from said adjacent node.

20. The method of claim 19, further comprising:  
 if said second resource response packet is not received within a predetermined  
     time interval,  
     releasing said resource allocated to said virtual path, and  
     forwarding a negative acknowledgment to said first node.

21. The method of claim 19, further comprising:  
 if said second resource response packet is received with at least one error,  
     releasing said resources allocated to said virtual path,  
     decrementing a hop count field in said second resource response  
         packet, and  
     forwarding said second resource response packet to said first node; and  
 if said second resource response packet is received with no errors,  
     determining if said second resource response packet includes a valid  
         list of a plurality of ports.

22. The method of claim 21, further comprising:  
 if said list of said plurality of ports is invalid,  
     releasing resources allocated to said virtual path, and  
     forwarding a negative acknowledgement to said first node;  
 if said list of said plurality of ports is valid,  
     determining if said plurality of ports is available;  
 if said plurality of ports is available,  
     assigning said plurality of ports to said virtual path, and  
     updating said virtual path information in a node database;  
 if said plurality of ports is not available,  
     adding an error code to said second resource response packet;  
     decrementing a hop count field in said second resource response packet; and  
     forwarding said second resource response packet to said first node.

23. The method of claim 18, further comprising:  
 if a state of said virtual path is one of 'restoring' and 'deleting',  
     copying said resource request packet to said first resource response  
         packet,  
     decrementing said hop count field in said first resource response  
         packet,  
     adding an error code of to said first resource response packet, and  
     responding with said first resource response packet.

24. The method of claim 8, wherein said second node receives said resource request packet.

25. The method of claim 24, further comprising:  
if said resource request packet includes invalid information,  
copying said resource request packet to a third resource response packet,  
decrementing a hop count field in said third resource response packet,  
adding an error code to said third resource response packet, and  
responding with said third resource response packet; and  
if said resource request packet includes valid information,  
determining if a resource is available for said virtual path.

26. The method of claim 25, further comprising:  
if said resource is available for said virtual path,  
copying said resource request packet to said third resource response packet,  
allocating said resource to said virtual path,  
updating said virtual path information in a node database,  
decrementing a hop count field in said third resource response packet,  
adding a list of a plurality of ports to said third resource response packet, and  
responding with said third resource response packet.

27. The method of claim 25, further comprising:  
if said resource is not available for said virtual path,  
copying said resource request packet to said third resource response packet,  
decrementing said hop count field in said third resource response packet,  
adding an error code to said third resource response packet, and  
responding with said third resource response packet.

28. The method of claim 24, further comprising:  
 if a state of said virtual path is one of 'restoring' and 'deleting',  
 copying said resource request packet to said third resource response  
 packet,  
 decrementing said hop count field in said third resource response  
 packet,  
 adding an error code to said third resource response packet, and  
 responding with said third resource response packet.

29. A network element configured to restore a virtual path in an optical  
 network, the network element comprising:  
 a processor;  
 a memory coupled to said processor; and  
 a network interface coupled to said processor; said processor configured to  
 identify a plurality of nodes with resources, wherein said nodes with  
 resources are ones of said nodes having a resource necessary to  
 support said virtual path, and  
 identify an alternate physical path, said alternate physical path  
 comprising ones of said nodes with resources.

30. The network element of claim 29, wherein said processor is further  
 configured to  
 restore said virtual path using said alternate physical path.

31. The network element of claim 29, wherein said processor is further  
 configured to  
 configure said alternate physical path by establishing a communication  
 connection between said ones of said nodes with resources; and  
 provision said virtual path over said alternate physical path.

1           32.    The network element of claim 29, wherein said processor is further  
2 configured to  
3           detect a failure in said virtual path;  
4           said detection of said failure is done by receiving a failure message packet;  
5           said virtual path is provisioned on a physical path between a first and a second  
6           node of said optical network;  
7           said optical network comprises said nodes;  
8           each one of said nodes is coupled to at least one another of said nodes by a  
9           plurality of optical links;  
10          said physical path between said first and said second node comprises a  
11          plurality of intermediate nodes; and  
12          each one of said nodes is coupled to at least one another of said nodes in a  
13          mesh topology.

1           33.    The network element of claim 32, wherein said processor is further  
2 configured to restore said virtual path in less than 2 seconds.

1           34.    The network element of claim 32, wherein said processor is further  
2 configured to restore said virtual path in less than 250 milliseconds.

1           35.    The method of claim 32, wherein  
2           said network element is configured as said first node; and  
3           said network element receives said failure message packet.

1           36.    The network element of claim 35, wherein said processor is further  
2 configured to  
3           (i)     change a state of said virtual path to restoring;  
4           (ii)    identify an adjacent node with required bandwidth for said  
5           virtual path;  
6           (iii)   forward a resource request packet to said adjacent node with  
7           required bandwidth for said virtual path;  
8           (iv)   wait for a resource response packet for a predetermined time  
9           interval; and



10 (v) if said resource response packet is not received within said  
 11 predetermined time interval,  
 12 repeat steps (ii) – (iv) for a predefined threshold times.

1 37. The network element of claim 36, wherein said processor is further  
 2 configured to  
 3 if said resource response packet is not received within said predefined  
 4 threshold time,  
 5 generate a network alarm.

1 38. The network element of claim 36, wherein said processor is further  
 2 configured to  
 3 if said resource response packet is received with at least one error,  
 4 wait until responses to all resource request packets are received; and  
 5 if said resource response packet is received with no errors,  
 6 determine if a list of allocated ports in said resource response packet is  
 7 valid.

1 39. The network element of claim 38, wherein said processor is further  
 2 configured to  
 3 if said list of allocated port is valid,  
 4 provision said virtual path on said allocated ports; and  
 5 if said list of allocated ports is invalid,  
 6 generate a network alarm.

1 40. The network element of claim 38, wherein said processor is further  
 2 configured to  
 3 if responses to all resource request packets are received with at least one error,  
 4 generate a network alarm.

1 41. The network element of claim 39, wherein said predetermined time  
 2 interval and predefined threshold are dynamically calculated by said network.

42. The network element of claim 4, wherein  
said network element is configured as one of said intermediate nodes, and  
said network element receives said failure message.

43. The network element of claim 42, wherein said processor is further  
configured to  
change a state of said virtual path to down;  
forward said failure message to adjacent nodes comprising said virtual path;  
initiate a timer for receiving a response to said forwarded failure message;  
if said timer expires before said response to said forwarded failure message is  
received,  
release resources of said virtual path; and  
if said response to said forwarded failure message is received before said timer  
expires,  
stop said timer, and  
release resources of said virtual path.

44. The network element of claim 32, wherein said processor is further  
configured to  
said network element is configured as said second node, and  
said network element receives said failure message.

45. The network element of claim 44, wherein said processor is further  
configured to  
acknowledge said failure message;  
change a state of said virtual path to down; and  
release resources of said virtual path.

46. The network element of claim 36, wherein  
said network element is configured as one of said intermediate nodes, and  
said network element receives said resource request packet.

1           47.    The network element of claim 46, wherein said processor is further  
2 configured to  
3           if said resource request packet includes at least one error,  
4                 copy said resource request packet to a first resource response packet,  
5                 decrement a hop count field in said first resource response packet,  
6                 add an error code to said first resource response packet, and  
7                 respond with said first resource response packet; and  
8           if said resource request packet includes no errors,  
9                 allocate a resource to said virtual path,  
10                increment a hop count field in said resource request packet,  
11                forward said resource request packet to an adjacent node having a  
12                 resource necessary to support said virtual path, and  
13                wait for a second resource response packet from said adjacent node.

1           48.    The network element of claim 47, wherein said processor is further  
2 configured to  
3           if said second resource response packet is not received within a predetermined  
4                 time interval,  
5                 release said resource allocated to said virtual path, and  
6                 forward a negative acknowledgment to said first node.

1           49.    The network element of claim 47, wherein said processor is further  
2 configured to  
3           if said second resource response packet is received with at least one error,  
4                 release said resources allocated to said virtual path,  
5                 decrement a hop count field in said second resource response packet,  
6                 and  
7                 forward said second resource response packet to said first node; and  
8           if said second resource response packet is received with no errors,  
9                 determine if said second resource response packet includes a valid list  
10                of a plurality of ports.

1           50.     The network element of claim 49, wherein said processor is further  
2 configured to

3           if said list of said plurality of ports is invalid,  
4                 release resources allocated to said virtual path, and  
5                 forward a negative acknowledgement to said first node;  
6           if said list of said plurality of ports is valid,  
7                 determine if said plurality of ports is available;  
8           if said plurality of ports is available,  
9                 assign said plurality of ports to said virtual path, and  
10                update said virtual path information in a node database;  
11           if said plurality of ports is not available,  
12                add an error code to said second resource response packet;  
13           decrement a hop count field in said second resource response packet; and  
14           forward said second resource response packet to said first node.

1           51.     The network element of claim 46, wherein said processor is further  
2 configured to

3           if a state of said virtual path is one of 'restoring' and 'deleting',  
4                 copy said resource request packet to said first resource response  
5                 packet,  
6                 decrement said hop count field in said first resource response packet,  
7                 add an error code of to said first resource response packet, and  
8                 respond with said first resource response packet.

1           52.     The network element of claim 36, wherein  
2 network element is configured as said second node, and  
3 said network element receives said resource request packet.

1           53.     The network element of claim 52, wherein said processor is further  
2 configured to

3           if said resource request packet includes invalid information,  
4                 copy said resource request packet to a third resource response packet,  
5                 decrement a hop count field in said third resource response packet,

add an error code to said third resource response packet, and  
 respond with said third resource response packet; and  
 if said resource request packet includes valid information,  
 determine if a resource is available for said virtual path.

54. The network element of claim 53, wherein said processor is further  
 configured to  
 if said resource is available for said virtual path,  
 copy said resource request packet to said third resource response  
 packet,  
 allocate said resource to said virtual path,  
 update said virtual path information in a node database,  
 decrement a hop count field in said third resource response packet,  
 add a list of a plurality of ports to said third resource response packet,  
 and  
 respond with said third resource response packet.

55. The network element of claim 53, wherein said processor is further  
 configured to  
 if said resource is not available for said virtual path,  
 copy said resource request packet to said third resource response  
 packet,  
 decrement said hop count field in said third resource response packet,  
 add an error code to said third resource response packet, and  
 respond with said third resource response packet.

56. The network element of claim 52, wherein said processor is further  
 configured to  
 if a state of said virtual path is one of 'restoring' and 'deleting',  
 copy said resource request packet to said third resource response  
 packet,  
 decrement said hop count field in said third resource response packet,  
 add an error code to said third resource response packet, and  
 respond with said third resource response packet.

1        57.    A computer system for restoring a virtual path in an optical network,  
2    said computer system comprising:  
3        means for identifying a plurality of nodes with resources, wherein said nodes  
4        with resources are ones of said nodes having a resource necessary to  
5        support said virtual path; and  
6        means for identifying an alternate physical path, said alternate physical path  
7        comprising ones of said nodes with resources.

1        58.    The computer system of claim 57, further comprising:  
2        means for restoring said virtual path using said alternate physical path.

1        59.    The computer system of claim 57, wherein said restoring is done by  
2        means for configuring said alternate physical path by establishing a  
3        communication connection between said ones of said nodes with  
4        resources; and  
5        means for provisioning said virtual path over said alternate physical path.

1        60.    The computer system of claim 58, further comprising:  
2        means for detecting a failure in said virtual path;  
3        said detection of said failure is done by receiving a failure message packet;  
4        said virtual path is provisioned on a physical path between a first and a second  
5        node of said optical network;  
6        said optical network comprises said nodes;  
7        each one of said nodes is coupled to at least one another of said nodes by a  
8        plurality of optical links;  
9        said physical path between said first and said second node comprises a  
10       plurality of intermediate nodes; and  
11       each one of said nodes is coupled to at least one another of said nodes in a  
12       mesh topology.

1        61.    The computer system of claim 60, wherein said restoring of said  
2       virtual path is completed in less than 2 seconds.

62. The computer system of claim 60, wherein said restoring of said virtual path is completed in less than 250 milliseconds.

63. The computer system of claim 60, wherein said first node receives said failure message packet.

64. The computer system of claim 63, further comprising:

- (i) means for changing a state of said virtual path to restoring;
- (ii) means for identifying an adjacent node with required bandwidth for said virtual path;
- (iii) means for forwarding a resource request packet to said adjacent node with required bandwidth for said virtual path;
- (iv) means for waiting for a resource response packet for a predetermined time interval; and

means for repeating steps (ii) – (iv) for a predefined threshold times if said resource response packet is not received within said predetermined time interval.

65. The computer system of claim 64, further comprising:

means for generating a network alarm if said resource response packet is not received within said predefined threshold time.

66. The computer system of claim 64, further comprising:

means for waiting until responses to all resource request packets are received if said resource response packet is received with at least one error; and  
means for determining if a list of allocated ports in said resource response packet is valid if said resource response packet is received with no errors.

67. The computer system of claim 66, further comprising:

means for provisioning said virtual path on said allocated ports if said list of allocated port is valid; and  
means for generating a network alarm if said list of allocated ports is invalid.

68. The computer system of claim 66, further comprising:  
means for generating a network alarm if responses to all resource request  
packets are received with at least one error.

69. The computer system of claim 65, wherein said predetermined time  
interval and predefined threshold are dynamically calculated by said network.

70. The computer system of claim 60, wherein one of said intermediate  
nodes receives said failure message.

71. The computer system of claim 70, further comprising:  
means for changing a state of said virtual path to down;  
means for forwarding said failure message to adjacent nodes comprising said  
virtual path;  
means for initiating a timer for receiving a response to said forwarded failure  
message;  
means for releasing resources of said virtual path if said timer expires before  
said response to said forwarded failure message is received;  
means for stopping said timer if said response to said forwarded failure  
message is received before said timer expires; and  
means for releasing resources of said virtual path if said response to said  
forwarded failure message is received before said timer expires.

72. The computer system of claim 60, wherein said second node receives  
said failure message.

73. The computer system of claim 72, further comprising:  
means for acknowledging said failure message;  
means for changing a state of said virtual path to down; and  
means for releasing resources of said virtual path.

74. The computer system of claim 64, wherein one of said intermediate  
nodes receives said resource request packet.



75. The computer system of claim 74, further comprising:  
means for copying said resource request packet to a first resource response  
packet if said resource request packet includes at least one error;  
means for decrementing a hop count field in said first resource response  
packet if said resource request packet includes at least one error;  
means for adding an error code to said first resource response packet if said  
resource request packet includes at least one error;  
means for responding with said first resource response packet if said resource  
request packet includes at least one error;  
means for allocating a resource to said virtual path if said resource request  
packet includes no errors;  
means for incrementing a hop count field in said resource request packet if  
said resource request packet includes no errors;  
means for forwarding said resource request packet to an adjacent node having  
a resource necessary to support said virtual path if said resource  
request packet includes no errors; and  
means for waiting for a second resource response packet from said adjacent  
node if said resource request packet includes no errors.

76. The computer system of claim 75, further comprising:  
means for releasing said resource allocated to said virtual path if said second  
resource response packet is not received within a predetermined time  
interval; and  
means for forwarding a negative acknowledgment to said first node if said  
second resource response packet is not received within a  
predetermined time interval.

77. The computer system of claim 75, further comprising:  
means for releasing said resources allocated to said virtual path if said second  
resource response packet is received with at least one error;  
means for decrementing a hop count field in said second resource response  
packet if said second resource response packet is received with at least  
one error;  
means for forwarding said second resource response packet to said first node if  
said second resource response packet is received with at least one  
error; and  
means for determining if said second resource response packet includes a valid  
list of a plurality of ports if said second resource response packet is  
received with no errors.

78. The computer system of claim 77, further comprising:  
means for releasing resources allocated to said virtual path if said list of said  
plurality of ports is invalid;  
means for forwarding a negative acknowledgement to said first node if said  
list of said plurality of ports is invalid;  
means for determining if said plurality of ports is available if said list of said  
plurality of ports is valid;  
means for assigning said plurality of ports to said virtual path if said plurality  
of ports is available;  
means for updating said virtual path information in a node database if said  
plurality of ports is available;  
means for adding an error code to said second resource response packet if said  
plurality of ports is not available;  
means for decrementing a hop count field in said second resource response  
packet; and  
means for forwarding said second resource response packet to said first node.

1        79.     The computer system of claim 74, further comprising:  
 2        means for copying said resource request packet to said first resource response  
 3                packet if a state of said virtual path is one of 'restoring' and 'deleting';  
 4        means for decrementing said hop count field in said first resource response  
 5                packet if a state of said virtual path is one of 'restoring' and 'deleting';  
 6        means for adding an error code of to said first resource response packet if a  
 7                state of said virtual path is one of 'restoring' and 'deleting'; and  
 8        means for responding with said first resource response packet if a state of said  
 9                virtual path is one of 'restoring' and 'deleting'.

1        80.     The computer system of claim 64, wherein said second node receives  
 2        said resource request packet.

1        81.     The computer system of claim 80, further comprising:  
 2        means for copying said resource request packet to a third resource response  
 3                packet if said resource request packet includes invalid information;  
 4        means for decrementing a hop count field in said third resource response  
 5                packet if said resource request packet includes invalid information;  
 6        means for adding an error code to said third resource response packet if said  
 7                resource request packet includes invalid information;  
 8        means for responding with said third resource response packet if said resource  
 9                request packet includes invalid information; and  
 10        means for determining if a resource is available for said virtual path if said  
 11                resource request packet includes valid information.

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82. The computer system of claim 81, further comprising:  
means for copying said resource request packet to said third resource response  
packet if said resource is available for said virtual path;  
means for allocating said resource to said virtual path if said resource is  
available for said virtual path;  
means for updating said virtual path information in a node database if said  
resource is available for said virtual path;  
means for decrementing a hop count field in said third resource response  
packet if said resource is available for said virtual path;  
means for adding a list of a plurality of ports to said third resource response  
packet if said resource is available for said virtual path; and  
means for responding with said third resource response packet.

83. The computer system of claim 81, further comprising:  
means for copying said resource request packet to said third resource response  
packet if said resource is not available for said virtual path;  
means for decrementing said hop count field in said third resource response  
packet if said resource is not available for said virtual path;  
means for adding an error code to said third resource response packet if said  
resource is not available for said virtual path; and  
means for responding with said third resource response packet.

84. The computer system of claim 80, further comprising:  
means for copying said resource request packet to said third resource response  
packet if a state of said virtual path is one of 'restoring' and 'deleting';  
means for decrementing said hop count field in said third resource response  
packet if a state of said virtual path is one of 'restoring' and 'deleting';  
means for adding an error code to said third resource response packet if a state  
of said virtual path is one of 'restoring' and 'deleting'; and  
means for responding with said third resource response packet.

85. A computer program product for restoring a virtual path in an optical network, encoded in computer readable media, said program product comprising a set of instructions executable on a computer system, said set of instructions configured to identify a plurality of nodes with resources, wherein said nodes with resources are ones of said nodes having a resource necessary to support said virtual path; and identifying an alternate physical path, said alternate physical path comprising ones of said nodes with resources.

86. The computer program product of claim 85, wherein said set of instructions is further configured to restore said virtual path using said alternate physical path.

87. The computer program product of claim 85, wherein said set of instructions is further configured to configure said alternate physical path by establishing a communication connection between said ones of said nodes with resources; and provision said virtual path over said alternate physical path.

88. The computer program product of claim 85, wherein said set of instructions is further configured to detect a failure in said virtual path; said detection of said failure is done by receiving a failure message packet; said virtual path is provisioned on a physical path between a first and a second node of said optical network; said optical network comprises said nodes; each one of said nodes is coupled to at least one another of said nodes by a plurality of optical links; said physical path between said first and said second node comprises a plurality of intermediate nodes; and each one of said nodes is coupled to at least one another of said nodes in a mesh topology.

89. The computer program product of claim 88, wherein said set of instructions is further configured to restore said virtual path in less than 2 seconds.

90. The computer program product of claim 88, wherein said set of instructions is further configured to restore said virtual path in less than 250 milliseconds.

91. The method of claim 88, wherein said first node receives said failure message packet.

92. The computer program product of claim 91, wherein said set of instructions is further configured to

- (i) change a state of said virtual path to restoring;
- (ii) identify an adjacent node with required bandwidth for said virtual path;
- (iii) forward a resource request packet to said adjacent node with required bandwidth for said virtual path;
- (iv) wait for a resource response packet for a predetermined time interval; and
- (v) if said resource response packet is not received within said predetermined time interval, repeat steps (ii) – (iv) for a predefined threshold times.

93. The computer program product of claim 92, wherein said set of instructions is further configured to

- if said resource response packet is not received within said predefined threshold time,
- generate a network alarm.

94. The computer program product of claim 94, wherein said set of instructions is further configured to

- if said resource response packet is received with at least one error,
- wait until responses to all resource request packets are received; and

5 if said resource response packet is received with no errors,  
 6 determine if a list of allocated ports in said resource response packet is  
 7 valid.

1 95. The computer program product of claim 94, wherein said set of  
 2 instructions is further configured to  
 3 if said list of allocated port is valid,  
 4 provision said virtual path on said allocated ports; and  
 5 if said list of allocated ports is invalid,  
 6 generate a network alarm.

1 96. The computer program product of claim 93, wherein said set of  
 2 instructions is further configured to  
 3 if responses to all resource request packets are received with at least one error,  
 4 generate a network alarm.

1 97. The computer program product of claim 88, wherein said  
 2 predetermined time interval and predefined threshold are dynamically calculated by  
 3 said network.

1 98. The computer program product of claim 88, wherein one of said  
 2 intermediate nodes receives said failure message.

1            99.     The computer program product of claim 88, wherein said set of  
2 instructions is further configured to  
3            change a state of said virtual path to down;  
4            forward said failure message to adjacent nodes comprising said virtual path;  
5            initiate a timer for receiving a response to said forwarded failure message;  
6            if said timer expires before said response to said forwarded failure message is  
7            received,  
8            release resources of said virtual path; and  
9            if said response to said forwarded failure message is received before said timer  
10           expires,  
11           stop said timer, and  
12           release resources of said virtual path.

1            100.    The computer program product of claim 88, wherein said second node  
2 receives said failure message.

1            101.    The computer program product of claim 100, wherein said set of  
2 instructions is further configured to  
3            acknowledge said failure message;  
4            change a state of said virtual path to down; and  
5            release resources of said virtual path.

1            102.    The computer program product of claim 92, wherein one of said  
2 intermediate nodes receives said resource request packet.

1            103.    The computer program product of claim 92, wherein said set of  
2 instructions is further configured to  
3            if said resource request packet includes at least one error,  
4            copy said resource request packet to a first resource response packet,  
5            decrement a hop count field in said first resource response packet,  
6            add an error code to said first resource response packet, and  
7            respond with said first resource response packet; and  
8            if said resource request packet includes no errors,



allocate a resource to said virtual path,  
 increment a hop count field in said resource request packet,  
 forward said resource request packet to an adjacent node having a  
 resource necessary to support said virtual path, and  
 wait for a second resource response packet from said adjacent node.

104. The computer program product of claim 103, wherein said set of  
 instructions is further configured to  
 if said second resource response packet is not received within a predetermined  
 time interval,  
 release said resource allocated to said virtual path, and  
 forward a negative acknowledgment to said first node.

105. The computer program product of claim 103, wherein said set of  
 instructions is further configured to  
 if said second resource response packet is received with at least one error,  
 release said resources allocated to said virtual path,  
 decrement a hop count field in said second resource response packet,  
 and  
 forward said second resource response packet to said first node; and  
 if said second resource response packet is received with no errors,  
 determine if said second resource response packet includes a valid list  
 of a plurality of ports.

106. The computer program product of claim 105, wherein said set of  
 instructions is further configured to  
 if said list of said plurality of ports is invalid,  
 release resources allocated to said virtual path, and  
 forward a negative acknowledgement to said first node;  
 if said list of said plurality of ports is valid,  
 determine if said plurality of ports is available;  
 if said plurality of ports is available,  
 assign said plurality of ports to said virtual path, and  
 update said virtual path information in a node database;

if said plurality of ports is not available,  
 add an error code to said second resource response packet;  
 decrement a hop count field in said second resource response packet; and  
 forward said second resource response packet to said first node.

107. The computer program product of claim 102, wherein said set of  
 instructions is further configured to  
 if a state of said virtual path is one of 'restoring' and 'deleting',  
 copy said resource request packet to said first resource response  
 packet,  
 decrement said hop count field in said first resource response packet,  
 add an error code of to said first resource response packet, and  
 respond with said first resource response packet.

108. The computer program product of claim 92, wherein said second node  
 receives said resource request packet.

109. The computer program product of claim 108, wherein said set of  
 instructions is further configured to  
 if said resource request packet includes invalid information,  
 copy said resource request packet to a third resource response packet,  
 decrement a hop count field in said third resource response packet,  
 add an error code to said third resource response packet, and  
 respond with said third resource response packet; and  
 if said resource request packet includes valid information,  
 determine if a resource is available for said virtual path.

110. The computer program product of claim 109, wherein said set of instructions is further configured to

if said resource is available for said virtual path,

copy said resource request packet to said third resource response packet,

allocate said resource to said virtual path,

update said virtual path information in a node database,

decrement a hop count field in said third resource response packet,

add a list of a plurality of ports to said third resource response packet,

and

respond with said third resource response packet.

111. The computer program product of claim 108, wherein said set of instructions is further configured to

if said resource is not available for said virtual path,

copy said resource request packet to said third resource response packet,

decrement said hop count field in said third resource response packet,

add an error code to said third resource response packet, and

respond with said third resource response packet.

112. The computer program product of claim 24, wherein said set of instructions is further configured to

if a state of said virtual path is one of 'restoring' and 'deleting',

copy said resource request packet to said third resource response packet,

decrement said hop count field in said third resource response packet,

add an error code to said third resource response packet, and

respond with said third resource response packet.